MULTIMEDIA UNIVERSITY

STUDENT ID NO

MULTIMEDIA UNIVERSITY

FINAL EXAMINATION

TRIMESTER 1, 2016/2017

PPH0255– PHYSICS

(Foundation in Information Technology)

19 OCTOBER 2016
9.00 A.M - 11.00 A.M
(2 Hours)

INSTRUCTIONS TO STUDENT

1. This question paper consists of 5 printed pages with 5 questions only, excluding the cover page physical constants and formula list.

2. Attempt **ALL** questions. All questions carry equal marks and the distribution of the marks for each question is given.

3. Please write all your answers in the Answer Booklet provided.

LIST OF PHYSICAL CONSTANTS

Acceleration due to gravity	g	$9.80\ \text{m/s}^2$
Electron mass	m_e	$9.11 \times 10^{-31}\ \text{kg}$
Proton mass	m_p	$1.67 \times 10^{-27}\ \text{kg}$
Elementary Charge	e	$1.602 \times 10^{-19}\ \text{C}$
Coulomb Constant	k	$9.0 \times 10^{9}\ \text{N m}^2.\ \text{C}^{-2}$
Permittivity of free space	ε_0	$8.85 \times 10^{-12}\ \text{C}^2\text{N}^{-1}.\text{m}^{-2}$

LIST OF FORMULA

NEWTONIAN MECHANICS

$$\omega = \frac{\Delta\theta}{\Delta t} \qquad v = r\omega \qquad a = r\alpha$$

$$\omega = \omega_o + \alpha t \qquad \theta = \frac{1}{2}(\omega_0 + \omega)t \qquad \theta = \omega_0 t + \frac{1}{2}\alpha t^2$$

$$\omega^2 = \omega_0^2 + 2\alpha\theta \qquad \theta = \omega t - \frac{1}{2}\alpha t^2$$

$$W = Fs\cos\theta \qquad KE = \frac{1}{2}mv^2 \qquad PE_G = mgy$$

$$P = \frac{W}{t} = \frac{E}{t} = \frac{Fd}{t} = F\bar{v} \qquad p = mv \qquad \sum F = \frac{\Delta p}{\Delta t}$$

$$m_1u_1 + m_2u_2 = m_1v_1 + m_2v_2 \qquad m_1u_1 + m_2u_2 = (m_1 + m_2)\,v$$

ELECTRICITY

$q = Ne$

$F = k\frac{q_1 q_2}{r^2}$

$E = \frac{F}{q_o}$

$E = k\frac{q}{r^2}$

$\Phi = EA\cos\theta$

$\Phi_c = \frac{q_{in}}{\varepsilon_o}$

$V = \frac{U}{q_o}$

$V = \frac{kq}{r}$

$U = k\frac{q_1 q_2}{r_{12}}$

$C = \frac{\varepsilon_0 A}{d}$

$Q = CV$

$C = \kappa C_0$

$C_{eq} = C_1 + C_2 + \ldots.$

$\frac{1}{C_{eq}} = \frac{1}{C_1} + \frac{1}{C_2} + \ldots.$

$V = E\,d$

$U = ½\,QV$

$U = ½\,CV^2$

$U = \frac{Q^2}{2C}$

$u_E = ½\,\varepsilon_o E^2$

$I_{av} = \frac{\Delta Q}{\Delta t}$

$V = IR$

$R = \rho\frac{L}{A}$

$R_{eq} = R_1 + R_2 + \ldots$

$\frac{1}{R_{eq}} = \frac{1}{R_1} + \frac{1}{R_2} + \ldots$

$P = IV$

$P = I^2R$

$P = \frac{V^2}{R}$

$V = E - Ir$

STRUCTURED QUESTIONS [50 MARKS]

Instructions: Answer **ALL** questions in this section. Write your answers in the Answer Booklet.

Question 1 [10 marks]

(a) State the "Principle of conservation of energy" **[1 mark]**

(b) A 0.26 kg rock is thrown vertically upward from the top of a cliff that is 32 m high. When it hits the ground at the base of the cliff the rock has a speed of 29 m/s. Assuming that air resistance can be ignored, find the

(i) initial speed of the rock and **[2 marks]**

(ii) greatest height of the rock as measured from the base of the cliff. **[2 marks]**

(c) Two air carts move toward one another on an air track. Cart 1 has a mass of 0.45 kg and a speed of 1.1 m/s. Cart 2 has a mass of 0.65 kg.

(i) What speed must cart 2 have if the total momentum of the system is to be zero? **[2 marks]**

(ii) Since the momentum of the system is zero, does it follow that the kinetic energy of the system is also zero? **[1 mark]**

(iii) Verify your answer to part c(ii) by calculating the system's kinetic energy **[2 marks]**

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Question 2 [10 marks]

(a) Define "Charge-force Law" and "Coulomb's Law" **[2 marks]**

(b) Compute the net charge of a system consisting of 5.0×10^8 electrons. **[1 mark]**

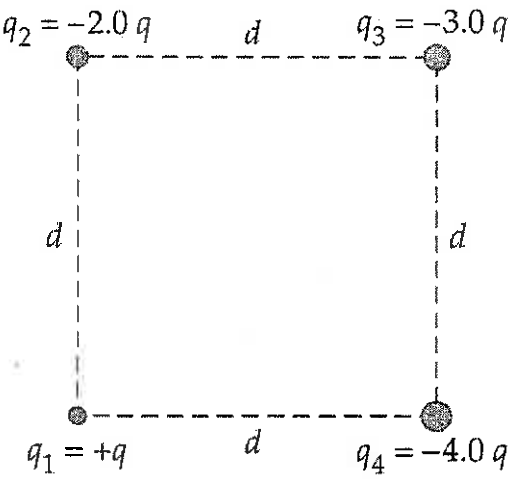

Figure 1

(c) Find the direction and magnitude of the net electrostatic force exerted on the point charge ***q3*** in **Figure 1**. Let $q = 2.0\ \mu C$ and $d = 33$ cm **[5 marks]**

(d) How would your answers to part 2(c) change if the distance ***d*** were doubled? **[2 marks]**

Question 3 [10 marks]

(a) State Gauss's law. **[1 mark]**

(b) Consider a spherical Gaussian surface and three charges $q_1 = 1.65\ \mu C$, $q_2 = -2.32\ \mu C$, and $q_3 = 3.71\ \mu C$. Find the electric flux through the Gaussian surface if it completely encloses

(i) only charges q_1 and q_2 and **[1 mark]**

(ii) all charges **[1 mark]**

(c) Suppose a fourth charge, Q, is added to the situation describe in part (b)(ii), find the sign and magnitude of Q required to give zero electric flux through the surface. **[2 marks]**

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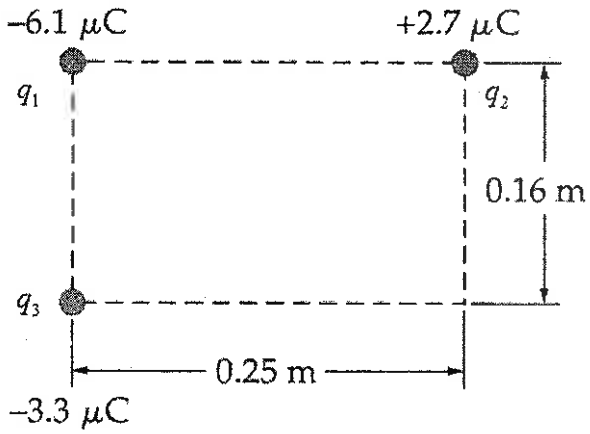

Figure 2

(d) **Figure 2** shows three charges at the corners of a rectangle.

(i) How much work must be done to move the +2.7 μC charge to infinity? **[3 marks]**

(ii) Suppose, instead that we move the -6.1 μC charge to infinity. Is the work required in this case greater than, less than or the same as when we moved the +2.7 μC charge to infinity? Explain. **[2 marks]**

Question 4 [10 marks]

(a) Define resistance and list down the four factors that affect the resistance of a wire. **[3 marks]**

(b) A bird lands on a bare copper wire carrying a current of 32 A. The cross sectional area of the copper wire is 0.13 cm^2. Find the difference in potential between the bird's feet, assuming they are separated by a distance of 6.0 cm. (Given: resistivity of copper wire = $1.72 \times 10^{-8} \Omega m$ **[2 marks]**

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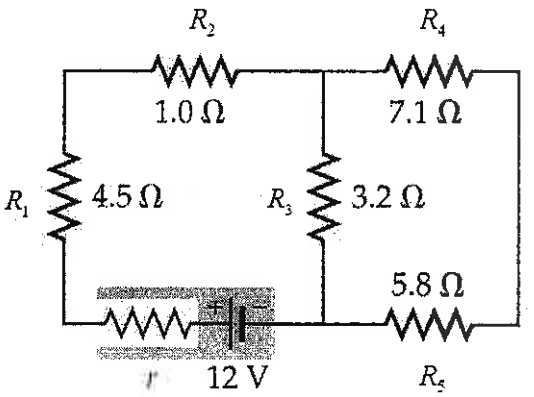

Figure 3

(c) **Figure 3** shows five resistors connected to a battery with an internal resistance $r = 0.25\ \Omega$.

(i) Find the equivalent resistance of the circuit. **[2 marks]**

(ii) How much current flows through the battery? **[1 mark]**

(iii) What is the potential difference between the terminals of the battery. **[2 marks]**

Question 5 [10 marks]

(a) Define the following terms:

(i) Free electrons.

(ii) Trivalent atom.

(iii) Doping.

(iv) Semiconductor.

(v) Minority carrier .

(vi) N-type semiconductor. **[3 marks]**

(b) Explain how a pure semiconductor is changed to *n*-type semiconductor. **[2 marks]**

(c)(i) A parallel plate capacitor has plates of area $3.45 \times 10^{-4}\ m^2$. The space between the plates is filled with paper where $k = 3.7$. What plate separation is required if the capacitance is to be 1330 pF? **[2 marks]**

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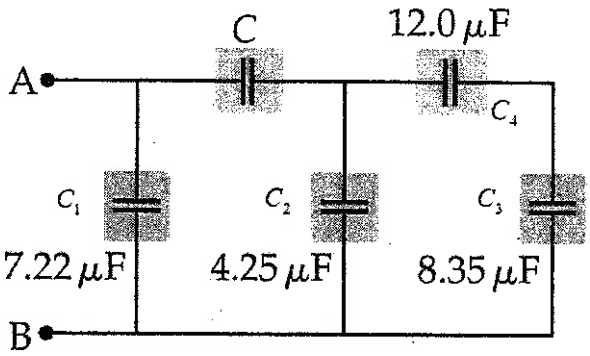

Figure 4

c(ii) The equivalent capacitance of the capacitors shown in **Figure 4** is 9.22 μF. Find the value of capacitor C. **[3 marks]**

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